

WHAT IS CLAIMED IS:

1. An electronic component mounting apparatus comprising:

a holding unit holding a board;

5 a mounting head equipped with a plurality of mounting nozzles for sucking/holding electronic components and having a mounting nozzle elevation mechanism for separately elevating said plural mounting nozzles;

electronic component supplying means which supplies
10 the electronic components to said mounting head;

a mounting head transport mechanism which transports said mounting head between said holding unit and said electronic component supplying means;

an observation head which acquires both an image of
15 a provisionally positioned electronic component and an image of an electronic component mounting portion from a space defined between the electronic component mounting portion and the provisionally positioned electronic component under such a condition that the electronic component sucked/held
20 by said mounting nozzle has been provisionally positioned above a plurality of electronic component mounting portions formed on said board;

an observation head transport mechanism which transports said observation head in synchronism with the
25 electronic components which are sequentially and

provisionally positioned by moving said mounting head, and also evacuates said observation head from an upper space of said holding unit when the electronic component is mounted on the board; and

5 control means which controls said mounting head transport mechanism based upon both the image of said electronic component and the image of said electronic component mounting portion, which have been acquired by said observation head, so as to sequentially position the
10 electronic components sucked/held by the respective mounting nozzles with respect to the electronic component mounting portions corresponding thereto.

2. An electronic component mounting apparatus as
15 claimed in claim 1, wherein said electronic component mounting apparatus includes interval changing means which changes an interval between said mounting head and said holding unit so as to narrow said interval after said observation head has been evacuated from said space.

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3. An electronic component mounting apparatus as
claimed in claim 2, wherein said interval changing means includes a holding unit elevation mechanism which elevates said holding unit; and a space of said holding unit along
25 a lateral direction is used as an evacuating position of said

observation head.

4. An electronic component mounting apparatus as claimed in claim 1, wherein said observation head includes
5 an electronic component-imaging camera which observes the electronic component; and a board-imaging camera which observes the electronic component mounting portion of the board.

10 5. An electronic component mounting apparatus as claimed in claim 4, wherein both an optical path of said electronic component-imaging camera and an optical path of said board-imaging camera are horizontally provided; and
said electronic component mounting apparatus further
15 comprises a prism which changes a direction of the optical path of said electronic component-imaging camera to an upper direction, and changes a direction of the optical path of said board-imaging camera to a lower direction at the same position.

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6. An electronic component mounting apparatus as claimed in claim 1, wherein said electronic component supplying means includes:

an electronic component supplying unit which supplies
25 the plural electronic components in such a manner that surfaces

of said plural electronic components, on which bumps are formed,
are turned upwardly; and

electronic component reversing/supplying means which
derives the electronic component from said electronic
5 component supplying unit and supplies said derived electronic
component under such a condition that up-down portions of
said derived electronic component are reversed.

7. An electronic component mounting apparatus as
10 claimed in claim 1, wherein said electronic component
supplying means includes:

an electronic component supplying unit which supplies
the plural electronic components in such a manner that surfaces
of said plural electronic components, on which bumps are formed,
15 are turned upwardly;

up-down reversing means which turns the electronic
component upside down; and

an electronic component transport mechanism which picks
up the electronic component from said electronic component
20 supplying unit and transports said picked-up electronic
component to said up-down reversing means.

8. An electronic component mounting apparatus as
claimed in claim 1, wherein said electronic component
25 supplying means includes:

an electronic component supplying unit which supplies the plural electronic components in such a manner that surfaces of said plural electronic components, on which bumps are formed, are turned upwardly; and

5 up-down reversing means which turns the electronic component upside down; and

said mounting head transport mechanism transports said mounting head over said electronic component supplying unit, said up-down reversing means, and said holding unit in order
10 that the electronic component of said electronic component supplying unit is transported to said up-down reversing means by said mounting head, and the electronic component reversed by said up-down reversing means is mounted on the board of said holding means by said mounting head.

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9. An electronic component mounting apparatus comprising:

a holding unit for holding a board;

a mounting head equipped with a plurality of mounting
20 nozzles for sucking/holding electronic components and having a mounting nozzle elevation mechanism for separately elevating said plural mounting nozzles;

electronic component supplying means which supplies the electronic components to said mounting head;

25 a mounting head transport mechanism which transports

said mounting head between said holding unit and said electronic component supplying means, in which the plural electronic components sucked/held by said plurality of mounting nozzles are mounted on a plurality of electronic component mounting portions;

a provisionally positioning operation processing part which sequentially positions the electronic components sucked/held by said plurality of mounting nozzles to an upper space of the electronic component mounting portions by controlling said mounting head transport mechanism;

observing means equipped with an observation head which acquires both an image of the provisionally positioned electronic component and an image of the electronic component mounting portion from a space defined between said provisionally positioned electronic component and said electronic component mounting portion every a set of said provisionally positioned electronic component and said electronic component mounting portion;

a provisional-positioning positional information storage part which stores thereinto a position of said mounting head when a provisional positioning operation is carried out as provisional-positioning positional information every said set;

a relative positional relationship calculating process part which calculates a relative positional relationship

between the electronic component sucked/held by the mounting nozzle and the electronic component mounting portion every said set based upon both the image of said electronic component and the image of said electronic component mounting portion
5 on which said electronic component is mounted, which have been acquired by said observation head;

a relative positional relationship storage part which stores thereinto the relative positional relationship calculated by said relative positional relationship
10 calculating process part every said set;

an alignment information calculating part which calculates alignment information used to position said mounting head based upon both said provisional-positioning positional information and said relative positional
15 relationship every said set, which have been stored into said provisional-positioning positional information storage part and said relative positional relationship storage part, respectively; and

a mounting operation processing part for controlling
20 said mounting head transport mechanism based upon said alignment information so as to sequentially position the electronic components sucked/held by the respective mounting nozzles with respect to the corresponding electronic component mounting portions and to mount said positioned
25 electronic components on said corresponding electronic

component mounting portions.

10. An electronic component mounting apparatus as
claimed in claim 9, wherein said electronic component mounting
5 apparatus includes interval changing means which changes an
interval between said mounting head and said holding unit
so as to narrow said interval after said observation head
has been evacuated from said space.

10 11. An electronic component mounting apparatus as
claimed in claim 10, wherein said interval changing means
includes a holding unit elevation mechanism which elevates
said holding unit; and a space of said holding unit along
a lateral direction is used as an evacuating position of said
15 observation head.

12. An electronic component mounting apparatus as
claimed in claim 9, wherein said observation head includes
an electronic component-imaging camera which observes the
20 electronic component; and a board-imaging camera which
observes the electronic component mounting portion of the
board.

13. An electronic component mounting apparatus as
25 claimed in claim 12, wherein both an optical path of said

electronic component-imaging camera and an optical path of said board-imaging camera are horizontally provided; and

said electronic component mounting apparatus further comprises a prism which changes a direction of the optical path of said electronic component-imaging camera to an upper direction, and changes a direction of the optical path of said board-imaging camera to a lower direction at the same position.

10 14. An electronic component mounting apparatus as claimed in claim 9, wherein said electronic component supplying means includes:

an electronic component supplying unit which supplies the plural electronic components in such a manner that surfaces of said plural electronic components, on which bumps are formed, are turned upwardly; and

15 electronic component reversing/supplying means which derives the electronic component from said electronic component supplying unit and supplies said derived electronic component under such a condition that up/down portions of said derived electronic component are reversed.

15 15. An electronic component mounting apparatus as claimed in claim 9, wherein said electronic component supplying means includes:

an electronic component supplying unit which supplies the plural electronic components in such a manner that surfaces of said plural electronic components, on which bumps are formed, are turned upwardly;

5 up-down reversing means which turns the electronic component upside down; and

an electronic component transport mechanism for picking up the electronic component from said electronic component supplying unit and for transporting said picked-up electronic component to said up-down reversing means.

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16. An electronic component mounting apparatus as claimed in claim 9, wherein said electronic component supplying means includes:

15 an electronic component supplying unit which supplies the plural electronic components in such a manner that surfaces of said plural electronic components, on which bumps are formed, are turned upwardly; and

up-down reversing means which turns the electronic component upside down; and

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said mounting head transport mechanism transports said mounting head over said electronic component supplying unit, said up-down reversing means, and said holding unit in order that the electronic component of said electronic component supplying unit is transported to said up-down reversing means

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by said mounting head, and the electronic component reversed by said up-down reversing means is mounted on the board of said holding means by said mounting head.

5 17. An electronic component mounting apparatus comprising:

 a holding unit for holding a board;

 a mounting head equipped with a plurality of mounting nozzles for sucking/holding electronic components and having
10 a mounting nozzle elevation mechanism for separately elevating said plural mounting nozzles;

 electronic component supplying means which supplies the electronic components to said mounting head;

 a mounting head transport mechanism which transports
15 said mounting head between said holding unit and said electronic component supplying means, in which the plural electronic components sucked/held by said plurality of mounting nozzles are mounted on a plurality of electronic component mounting portions;

20 a provisionally positioning operation processing part which sequentially positions the electronic components sucked/held by said plurality of mounting nozzles to an upper space of the electronic component mounting portions by controlling said mounting head transport mechanism;

25 observing means equipped with an observation head which

acquires both an image of the provisionally positioned electronic component and an image of the electronic component mounting portion from a space defined between said provisionally positioned electronic component and said electronic component mounting portion every a set of said provisionally positioned electronic component and said electronic component mounting portion;

a relative positional relationship calculating process part which calculates a relative positional relationship between the electronic component sucked/held by the mounting nozzle and the electronic component mounting portion every said set based upon both the image of said electronic component and the image of said electronic component mounting portion on which said electronic component is mounted, which have been acquired by said observation head;

an alignment information calculating part which calculates alignment information used to position said mounting head based upon both a position of said mounting head when said provisional positioning operation is carried out and said relative positional information;

an alignment information storage part which stores thereinto said alignment information calculated by said alignment information calculating part every said set; and

a mounting operation processing part which controls said mounting head transport mechanism based upon said

alignment information so as to sequentially position the electronic components sucked/held by the respective mounting nozzles with respect to the corresponding electronic component mounting portions and to mount said positioned
5 electronic components on said corresponding electronic component mounting portions.

18. An electronic component mounting apparatus as claimed in claim 17, wherein said electronic component
10 mounting apparatus includes interval changing means which changes an interval between said mounting head and said holding unit so as to narrow said interval after said observation head has been evacuated from said space.

15 19. An electronic component mounting apparatus as claimed in claim 18, wherein said interval changing means includes a holding unit elevation mechanism which elevates said holding unit; and a space of said holding unit along a lateral direction is used as an evacuating position of said
20 observation head.

20. An electronic component mounting apparatus as claimed in claim 17, wherein said observation head includes an electronic component-imaging camera which observes the
25 electronic component; and a board-imaging camera which

observes the electronic component mounting portion of the board.

21. An electronic component mounting apparatus as
5 claimed in claim 20, wherein both an optical path of said electronic component-imaging camera and an optical path of said board-imaging camera are horizontally provided; and

said electronic component mounting apparatus further
comprises a prism which changes a direction of the optical
10 path of said electronic component-imaging camera to an upper direction, and changes a direction of the optical path of said board-imaging camera to a lower direction at the same position.

15 22. An electronic component mounting apparatus as claimed in claim 17, wherein said electronic component supplying means includes:

an electronic component supplying unit which supplies
the plural electronic components in such a manner that surfaces
20 of said plural electronic components, on which bumps are formed, are turned upwardly; and

electronic component reversing/supplying means which
derives the electronic component from said electronic
component supplying unit and supplies said derived electronic
25 component under such a condition that up/down portions of

said derived electronic component are reversed.

23. An electronic component mounting apparatus as claimed in claim 17, wherein said electronic component
5 supplying means includes:

an electronic component supplying unit which supplies the plural electronic components in such a manner that surfaces of said plural electronic components, on which bumps are formed, are turned upwardly;

10 up-down reversing means which turns the electronic component upside down; and

an electronic component transport mechanism for picking up the electronic component from said electronic component supplying unit and for transporting said picked-up electronic
15 component to said up-down reversing means.

24. An electronic component mounting apparatus as claimed in claim 17, wherein said electronic component supplying means includes:

20 an electronic component supplying unit which supplies the plural electronic components in such a manner that surfaces of said plural electronic components, on which bumps are formed, are turned upwardly; and

up-down reversing means which turns the electronic
25 component upside down; and

said mounting head transport mechanism transports said mounting head over said electronic component supplying unit, said up-down reversing means, and said holding unit in order that the electronic component of said electronic component supplying unit is transported to said up-down reversing means
5 by said mounting head, and the electronic component reversed by said up-down reversing means is mounted on the board of said holding means by said mounting head.

10 25. An electronic component mounting method in which an electronic component is sucked and held by each of a plurality of mounting nozzles provided in a mounting head so as to be mounted on an electronic component mounting portion of a board, comprising:

15 a component holding step for sucking and holding electronic components by said plurality of mounting nozzles of said mounting head;

 a provisional positioning step for provisionally positioning the electronic component sucked and held by one
20 of said plural mounting nozzles above one electronic component mounting portion;

 an observing step in which both an image of the provisionally positioned electronic component and an image of the electronic component mounting portion are acquired
25 by an observation head located in a space defined between

said provisionally positioned electronic component and the electronic component mounting portion;

5 a relative positional relationship detecting step for detecting a relative positional relationship between said provisionally positioned electronic component and said electronic component mounting portion based upon said images of both said electronic component and said electronic component mounting portion, which are acquired in said observing step;

10 a step for sequentially executing said provisional positioning step, said observing step, and said relative positional relationship detecting step as to all of the electronic components sucked and held by other mounting nozzles;

15 an observation head evacuating step for evacuating said observation head from an upper space of the board; and

a step in which such a mounting operation that the electronic components sucked and held by said plurality of mounting nozzles are positioned so as to be mounted on the electronic component mounting portions by transporting said mounting head while reflecting thereto the relative positional relationship detected in said relative positional relationship detecting step is carried out with respect to all of the electronic components.

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26. An electronic component mounting method as claimed in claim 25, wherein after said observation head evacuating step, an interval changing step for narrowing an interval between said board and said mounting nozzles is
5 executed; and thereafter, said mounting operation is carried out while said mounting nozzles are elevated.

27. An electronic component mounting method as claimed in claim 26, wherein said interval changing step causes
10 the board to ascend with respect to said mounting head.

28. An electronic component mounting method as claimed in claim 25, wherein the electronic component corresponds to such an electronic component in which a
15 plurality of bumps have been formed on a surface thereof; and said bumps are mounted on electrodes of the electronic component mounting portions of said board.

29. An electronic component mounting method as
20 claimed in claim 28, further comprising:

a step for reversing the electronic component supplied in such a manner that the plane of said electronic component where the bumps have been formed is directed to an upper direction, and for supplying the reversed electronic
25 component to said mounting head.

30. An electronic component mounting method as claimed in claim 28, further comprising:

an electronic component transporting step for
5 transporting the electronic component supplied in such a manner that the plane of said electronic component where the bumps have been formed is directed to the upper direction to up-down reversing means by an electronic component transport mechanism;

10 an up-down reversing step for turning the electronic component upside down by the up-down reversing means; and a step for picking up the up-down reversed electronic component by said mounting head.

15 31. An electronic component mounting method as claimed in claim 28, further comprising:

an electronic component transporting step for
transporting the electronic component supplied in such a manner that the plane of said electronic component where the
20 bumps have been formed is directed to the upper direction to up-down reversing means by said mounting head;

an up-down reversing step for turning the electronic component upside down by the up-down reversing means; and
a step for picking up the up-down reversed electronic
25 component by said mounting head.

32. An electronic component mounting method in which
an electronic component is sucked/held by each of a plurality
of mounting nozzles provided in a mounting head so as to be
5 mounted on an electronic component mounting portion of a board,
comprising:

a component holding step for sucking and holding
electronic components by said plurality of mounting nozzles
of said mounting head;

10 a provisional positioning step for provisionally
positioning the electronic component sucked and held by one
of said plural mounting nozzles above one electronic component
mounting portion;

an observing step in which one set of both an image
15 of the provisionally positioned electronic component and an
image of the electronic component mounting portion are
acquired by an observation head located in a space defined
between said provisionally positioned electronic component
and the electronic component mounting portion;

20 a relative positional relationship detecting step for
detecting a relative positional relationship between said
provisionally positioned electronic component and said
electronic component mounting portion based upon said images
of both said electronic component and said electronic
25 component mounting portion, which are acquired in said

observing step;

a storage step for storing thereinto said relative positional relationship and provisional positioning positional information corresponding to positional information of said provisionally positioned mounting head;

a step in which since said provisional positioning step, said observing step, said relative positional relationship detecting step, and said storage step are sequentially executed every a set of both all of said electronic components sucked and held by other mounting nozzles and the electronic component mounting portions on which said electronic components are mounted, both the provisional positioning positional information and the relative positional relationship are stored every said set;

an observation head evacuating step for evacuating said observation head from an upper space of the board; and a step in which alignment information is calculated every said set based upon said stored provisional positioning positional information and said stored relative positional information, and then, such a mounting operation is executed every said set, in which the electronic components are positioned so as to be mounted with respect to the electronic component mounting portions by transporting said mounting head based upon said alignment information.

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33. An electronic component mounting method as claimed in claim 32, wherein after said observation head evacuating step, an interval changing step for narrowing an interval between said board and said mounting nozzles is
5 executed; and thereafter, said mounting operation is carried out while said mounting nozzles are elevated.

34. An electronic component mounting method as claimed in claim 33, wherein said interval changing step causes
10 the board to ascend with respect to said mounting head.

35. An electronic component mounting method as claimed in claim 32, wherein the electronic component corresponds to such an electronic component in which a
15 plurality of bumps have been formed on a surface thereof; and said bumps are mounted on electrodes of the electronic component mounting portions of said board.

36. An electronic component mounting method as
20 claimed in claim 35, further comprising:

a step for reversing the electronic component supplied in such a manner that the plane of said electronic component where the bumps have been formed is directed to an upper direction, and for supplying the reversed electronic
25 component to said mounting head.

37. An electronic component mounting method as claimed in claim 35, further comprising:

an electronic component transporting step for
5 transporting the electronic component supplied in such a manner that the plane of said electronic component where the bumps have been formed is directed to the upper direction to up-down reversing means by an electronic component transport mechanism;

10 an up-down reversing step for turning the electronic component upside down by the up-down reversing means; and a step for picking up the up-down reversed electronic component by said mounting head.

15 38. An electronic component mounting method as claimed in claim 35, further comprising:

an electronic component transporting step for
transporting the electronic component supplied in such a manner that the plane of said electronic component where the
20 bumps have been formed is directed to the upper direction to up-down reversing means by said mounting head;

an up-down reversing step for turning the electronic component upside down by the up-down reversing means; and
a step for picking up the up-down reversed electronic
25 component by said mounting head.

39. An electronic component mounting method in which an electronic component is sucked and held by each of a plurality of mounting nozzles provided in a mounting head so as to be mounted on an electronic component mounting portion
5 of a board, comprising:

a component holding step for sucking and holding electronic components by said plurality of mounting nozzles of said mounting head;

10 a provisional positioning step for provisionally positioning the electronic component sucked and held by one of said plural mounting nozzles above one electronic component mounting portion;

an observing step in which one set of both an image
15 of the provisionally positioned electronic component and an image of the electronic component mounting portion are acquired by an observation head located in a space defined between said provisionally positioned electronic component and the electronic component mounting portion;

20 a relative positional relationship detecting step for detecting a relative positional relationship between said provisionally positioned electronic component and said electronic component mounting portion based upon said images of both said electronic component and said electronic
25 component mounting portion, which are acquired in said

observing step;

an alignment information calculating step for
calculating alignment information based upon both said
relative positional relationship and provisional positioning
5 positional information corresponding to positional
information of said provisionally positioned mounting head;

a storage step for storing therein said calculated
alignment information;

a step in which since said provisional positioning step,
10 said observing step, said relative positional relationship
detecting step, said alignment information calculating step,
and said storage step are sequentially executed every a set
of both all of said electronic components sucked and held
by other mounting nozzles and the electronic component
15 mounting portions on which said electronic components are
mounted, alignment information is stored every said set;

an observation head evacuating step for evacuating said
observation head from an upper space of the board; and

a step in which such a mounting operation is executed
20 every said set, in which the electronic components are
positioned so as to be mounted with respect to the electronic
component mounting portions by transporting said mounting
head based upon said stored alignment information.

25 40. An electronic component mounting method as

claimed in claim 39, wherein after said observation head
evacuating step, an interval changing step for narrowing an
interval between said board and said mounting nozzles is
executed; and thereafter, said mounting operation is carried
5 out while said mounting nozzles are elevated.

41. An electronic component mounting method as
claimed in claim 40, wherein said interval changing step causes
the board to ascend with respect to said mounting head.
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42. An electronic component mounting method as
claimed in claim 39, wherein the electronic component
corresponds to such an electronic component in which a
plurality of bumps have been formed on a surface thereof;
15 and said bumps are mounted on electrodes of the electronic
component mounting portions of said board.

43. An electronic component mounting method as
claimed in claim 42, further comprising:
20 a step for reversing the electronic component supplied
in such a manner that the plane of said electronic component
where the bumps have been formed is directed to an upper
direction, and for supplying the reversed electronic
component to said mounting head.

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44. An electronic component mounting method as claimed in claim 42, further comprising:

an electronic component transporting step for transporting the electronic component supplied in such a manner that the plane of said electronic component where the bumps have been formed is directed to the upper direction to up-down reversing means by an electronic component transport mechanism;

an up-down reversing step for turning the electronic component upside down by the up-down reversing means; and a step for picking up the up-down reversed electronic component by said mounting head.

45. An electronic component mounting method as claimed in claim 42, further comprising:

an electronic component transporting step for transporting the electronic component supplied in such a manner that the plane of said electronic component where the bumps have been formed is directed to the upper direction to up-down reversing means by said mounting head;

an up-down reversing step for turning the electronic component upside down by the up-down reversing means; and

a step for picking up the up-down reversed electronic component by said mounting head.